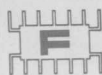


FAIRMONT electronics (pty) ltd.

P.O. Box 41102
 Craighall
 2024



Tel: 789-1230/4
 Telex: 4-24842 SA

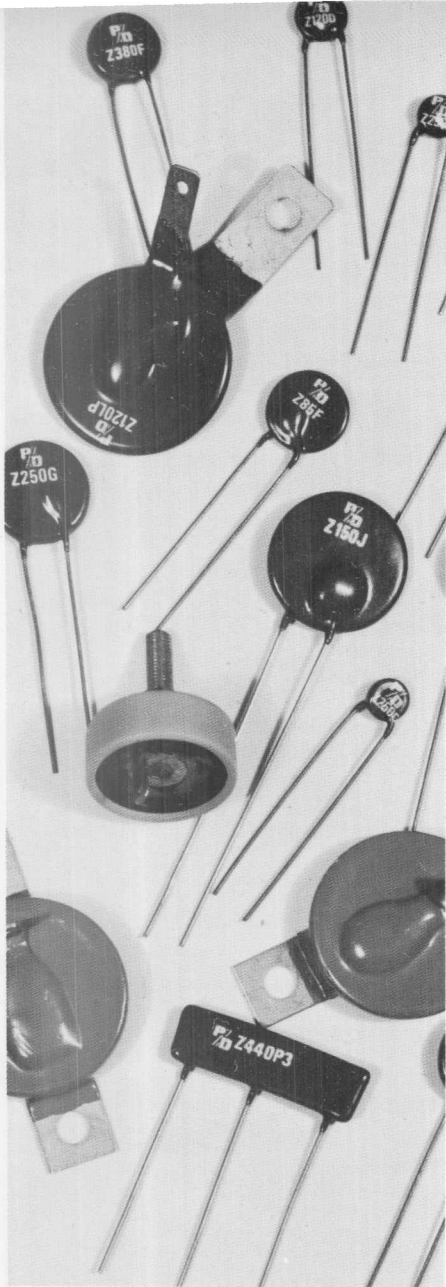
TRANSIENT VOLTAGE PROTECTION

(Z_nO) METAL OXIDE
 VARISTORS



P/D

POWER DEVELOPMENT LTD.



Power Development Zinc Oxide Transient Clippers, specifically designed to suppress voltage transients, have now been further developed to give better protection, greater energy handling, and longer life. An extended range of voltage ratings and new High Power chassis mounting types together with Transient Protection units in single phase or 3-phase Industrial versions complete the range. Wholly developed and manufactured in Great Britain, the increased performance of this new range is such that many Transient Voltage problems are now solved using smaller devices saving space, weight and cost.

Transient Clippers are suitable for use on AC and DC systems and pass only a few microAmps at rated voltage. In the presence of a voltage transient the very high non-linear index responds within nanoseconds to present a low resistance path suppressing the transient to the low levels shown in the tables and curves.

Essentially a back to back symmetrical diode with characteristic similar to a zener, Transient Clippers are manufactured in England from a blend of zinc oxide and other metal oxides which are pressed and sintered according to our own patented processes. Contacts are made and wires attached before being coated in a tough epoxy finish which is moisture and flame resistant.

Source of Transient

Motors
Transformers
Thermostats
Fluorescent chokes
Air conditioning
Relays
Pumps
Starter coils
Fuses
Atmospheric/lightning
Induced switching effects
Actuators
Solenoids
Spot welders
Electromagnets
Discharge lamps

SOURCE

In any electrical circuit a rapid change in current will generate voltage transients. Its size and duration will depend on the rate of change of current and circuit inductance and capacitance (Ldi/dt). On the left are listed some of the many equipments which habitually generate transients capable of causing damage to sensitive equipment.

SENSITIVE AREAS

On the right are listed some of the many equipments making use of semiconductor devices which are likely to fail if exposed to voltage transients. Properly protected with Transient Clippers these devices are not only made more reliable but also safer and frequently cheaper because less expensive semiconductor devices can be employed.

Sensitive Areas

Power supplies
Speed controllers
Timers
Programmable
Amplifiers
Inverters
Oscilloscopes
Mains filters
Amusement machines
Telephony
Instrumentation
Contact protection
Insulation
Cash registers
Computers
Auto washing machines
Cooker controls
Security systems
Dimmers
Spot welder timers
Lighting controllers
Television
Proximity switches
Sensonic
Street lighting
Medical analysis equipment

Why 'Surge protection'?

Quite simply because semi-conductors and Voltage Transients DON'T MIX. There are few examples of modern sophisticated electrical equipment which don't make use of solid state devices, and most electrical equipment generates transients when switched. Such transients will cause breakdown or malfunction

of unprotected voltage sensitive semi-conductors.

Since the beginning of electrical engineering designers have had to protect installations against the effects of unwanted over voltages. The most obvious sources being lightning and

switching. Earlier designs using generous clearances, heavy insulation, thermionic valve electronics presented few problems. Modern sophisticated designs in both electronics and power with high component densities and low withstand semi-conductors, demand an effective method of over-voltage protection.

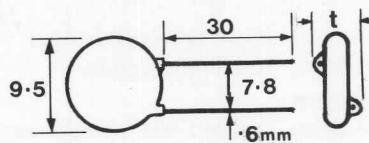
Why 'TRANSIENT CLIPPERS'?

Because **Power Development Transient Clippers** are specifically designed to give a better all-round standard of protection than other methods. There are many ways to suppress transients: — the trad-

itional CR circuit — spark gaps — diodes — crowbars — silicon carbide varistors etc. but none of these can combine the cumulative advantages of **Power Development Transient Clippers**, viz:

High non-Linear Index
Fast Response...a few nanoseconds
Low Clamping Voltage
Low Drain Current...typically microAmps
High Current Withstand: up to 8kA on
wired types/up to 15kA on chassis
mounting types
High Energy Withstand: up to 275J on
wired discs/more on chassis
mounting types
Suitable for AC and DC circuits
Wide range of Voltage/energy Ratings
Small package size Low Cost

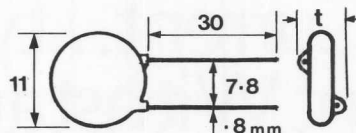
'C' RANGE



800 Amps 8/20 max.
30 Joules 10/1000 max.
7.5 mm Disc dia.

Max cont volts AC rms at 25°C	Type ref.	Max cont volts DC at 25°C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 5 Amps	m Watts cont	Cap pF.	Dim t mm	Type ref.
75	Z60C	90	100	3	190	200	300	3.5	Z60C
95	Z85C	123	135	7	240	250	300	3.5	Z85C
121	Z110C	157	171	9	320	250	250	4.0	Z110C
132	Z120C	172	187	10	350	250	250	4.0	Z120C
150	Z135C	195	210	11	375	250	200	4.5	Z135C
165	Z150C	214	233	12	400	250	200	4.5	Z150C
200	Z180C	260	283	16	510	300	200	5.0	Z180C
250	Z220C	325	353	20	570	300	150	5.0	Z220C
275	Z250C	358	389	20	620	300	150	5.5	Z250C
320	Z280C	416	450	22	720	300	100	6.0	Z280C
352	Z320C	458	498	24	820	300	100	6.5	Z232C
420	Z380C	546	594	26	980	300	90	7.0	Z380C
460	Z415C	598	650	28	1080	350	80	7.5	Z415C
484	Z440C	629	685	30	1160	350	80	8.0	Z440C

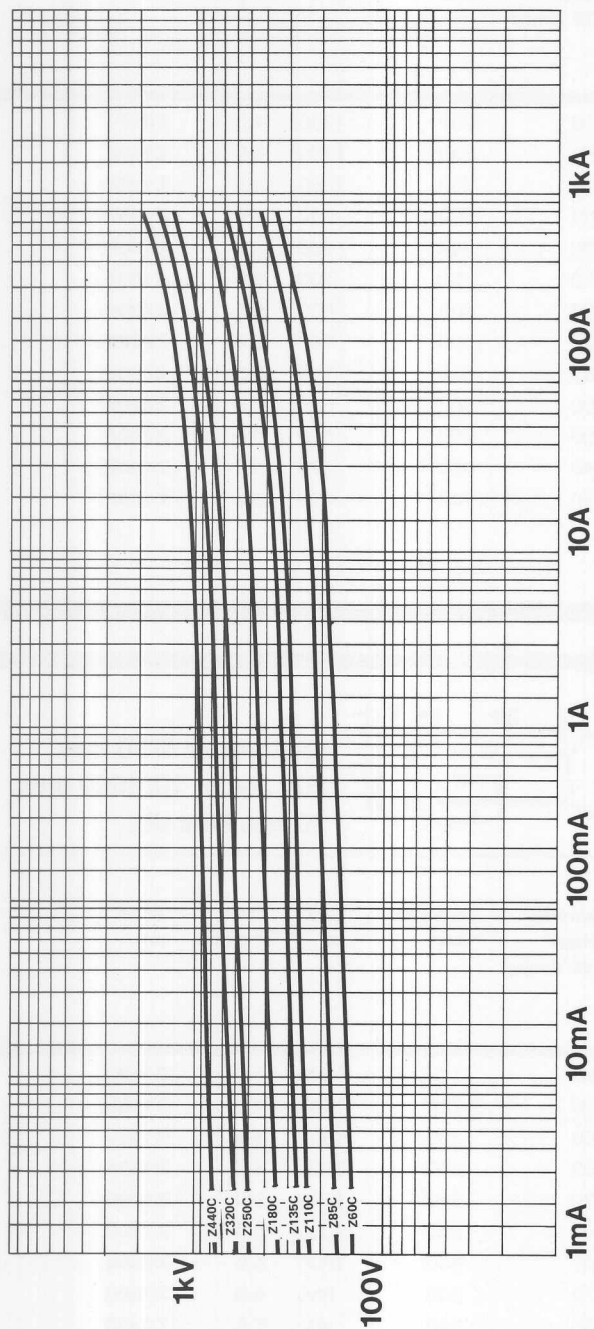
'D' RANGE



1200 Amps 8/20 max.
40 Joules 10/1000 max.
9.5 mm Disc dia.

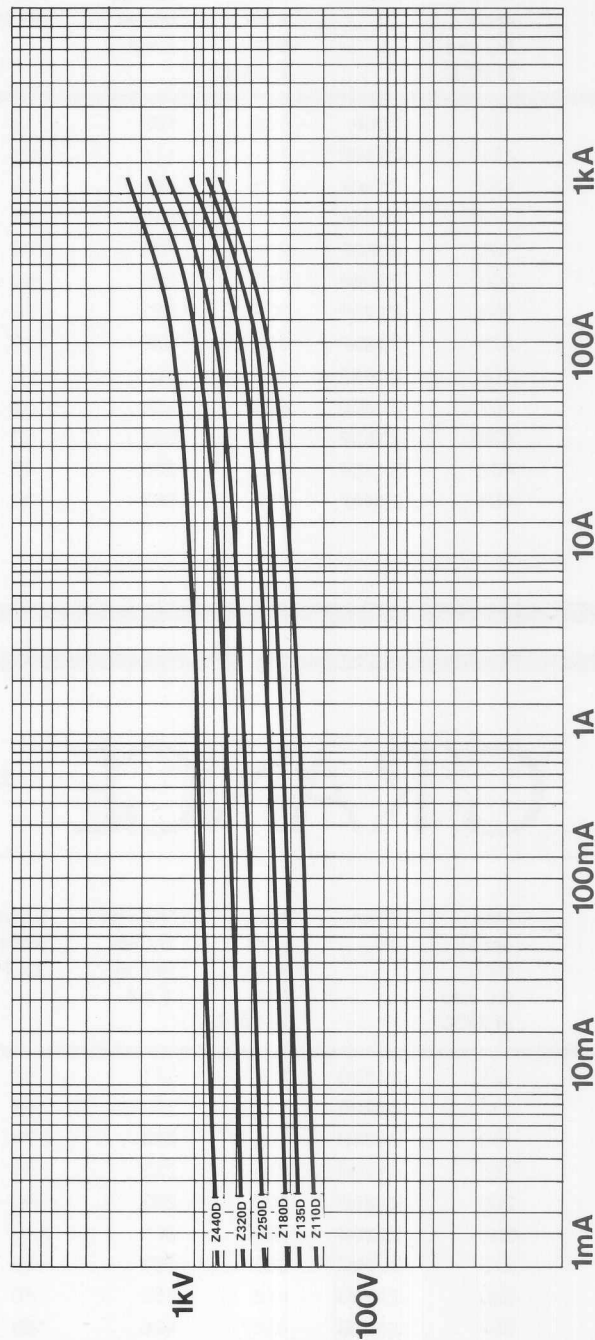
Max cont volts AC rms at 25°C	Type ref.	Max cont volts DC at 25°C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 10 Amps	m Watts cont	Cap pF.	Dim t mm	Type ref.
121	Z110D	157	171	12	300	300	420	4.0	Z110D
132	Z120D	172	187	15	325	325	360	4.0	Z120D
150	Z135D	195	210	17	355	350	330	4.5	Z135D
165	Z150D	214	233	18	385	350	300	4.5	Z150D
200	Z180D	260	283	25	510	350	260	5.0	Z180D
250	Z220D	325	353	28	580	400	220	5.0	Z220D
275	Z250D	358	389	30	640	400	190	5.5	Z250D
320	Z280D	416	450	32	760	500	175	6.0	Z280D
352	Z320D	458	498	34	830	500	160	6.5	Z320D
420	Z380D	546	594	36	960	550	135	7.0	Z380D
460	Z415D	598	650	38	1020	550	120	7.0	Z415D
484	Z440D	629	685	40	1140	550	110	8.0	Z440D

'C' RANGE



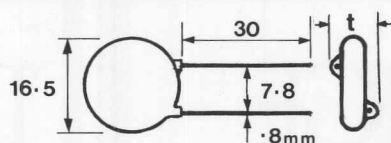
To improve readability some curves have been omitted but the information may be obtained by pro-rating.

'D' RANGE



To improve readability some curves have been omitted but the information may be obtained by pro-rating.

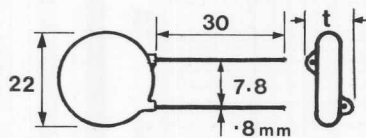
'F' RANGE



4500 Amps 8/20 max.
100 Joules 10/1000 max.
14 mm Disc dia.

Max cont volts AC rms at 25° C	Type ref.	Max cont volts DC at 25° C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 20 Amps	m Watts cont	Cap pF.	Dim t mm	Type ref.
95	Z85F	123	135	15	210	500	1200	4.0	Z85F
121	Z110F	157	171	22	290	500	1100	4.0	Z110F
132	Z120F	172	187	38	320	500	1000	4.5	Z120F
150	Z135F	195	210	45	355	550	930	4.5	Z135F
165	Z150F	214	233	50	390	550	850	5.0	Z150F
200	Z180F	260	283	60	510	550	700	5.0	Z180F
250	Z220F	325	353	70	600	600	600	5.5	Z220F
275	Z250F	358	389	75	660	600	580	6.0	Z250F
320	Z280F	416	450	80	780	600	550	6.5	Z280F
352	Z320F	458	498	85	850	600	525	7.0	Z320F
420	Z380F	546	594	90	960	650	500	7.5	Z380F
460	Z415F	598	650	95	1040	650	475	8.0	Z415F
484	Z440F	629	685	100	1140	700	450	8.5	Z440F

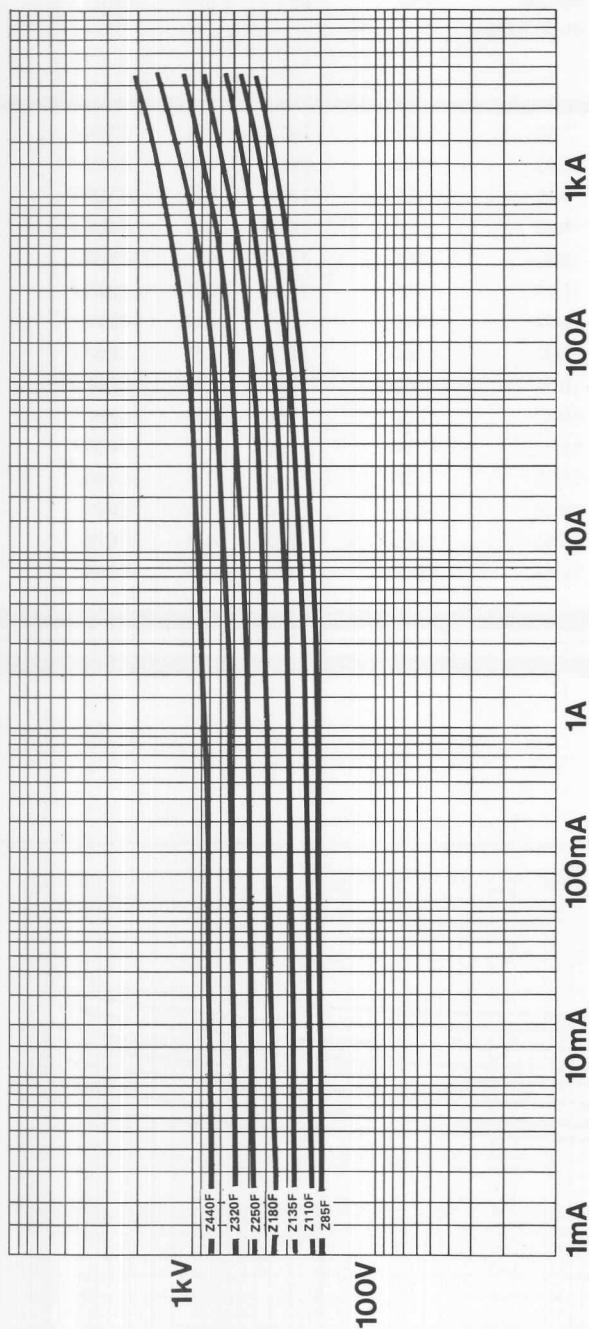
'G' RANGE



6500 Amps 8/20 max.
200 Joules 10/1000 max.
20 mm Disc dia.

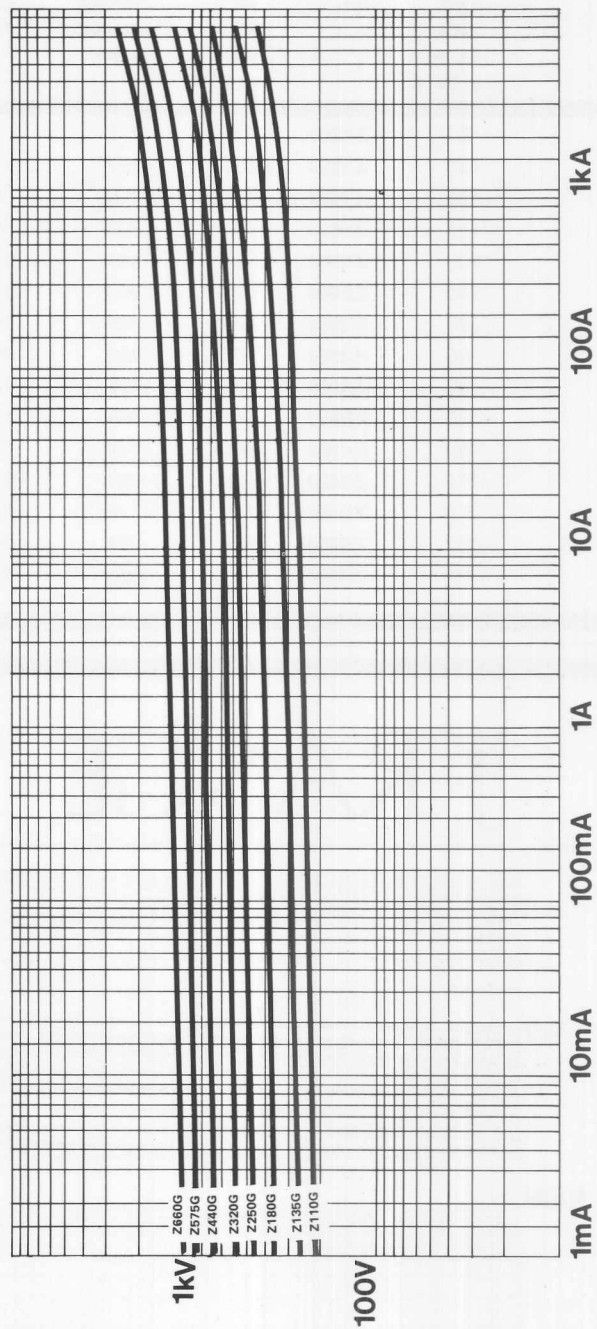
Max cont volts AC rms at 25° C	Type ref.	Max cont volts DC at 25° C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 40 Amps	m Watts cont	Cap pF.	Dim t mm	Type ref.
121	Z110G	157	171	50	285	700	1500	4.0	Z110G
132	Z120G	172	187	65	320	700	1400	4.0	Z120G
150	Z135G	195	210	75	360	700	1300	4.5	Z135G
165	Z150G	214	233	80	400	700	1200	4.5	Z150G
200	Z180G	260	283	90	520	800	1100	5.0	Z180G
250	Z220G	325	353	110	600	800	1000	5.0	Z220G
275	Z250G	358	389	130	665	800	1000	5.5	Z250G
320	Z280G	416	450	140	770	800	950	6.0	Z280G
352	Z320G	458	498	150	850	800	900	6.5	Z320G
420	Z380G	546	594	160	980	900	850	7.0	Z380G
460	Z415G	598	650	170	1080	900	800	7.0	Z415G
484	Z440G	629	685	180	1180	900	750	8.0	Z440G
550	Z500G	715	778	190	1330	900	700	8.0	Z500G
632	Z575G	822	894	195	1500	1000	650	8.0	Z575G
726	Z660G	944	1027	200	1700	1000	600	9.0	Z660G

'F' RANGE



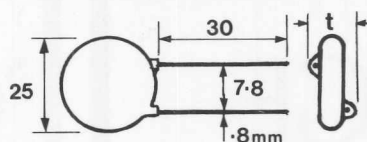
To improve readability some curves have been omitted but the information may be obtained by pro-rating.

'G' RANGE



To improve readability some curves have been omitted but the information may be obtained by pro-rating.

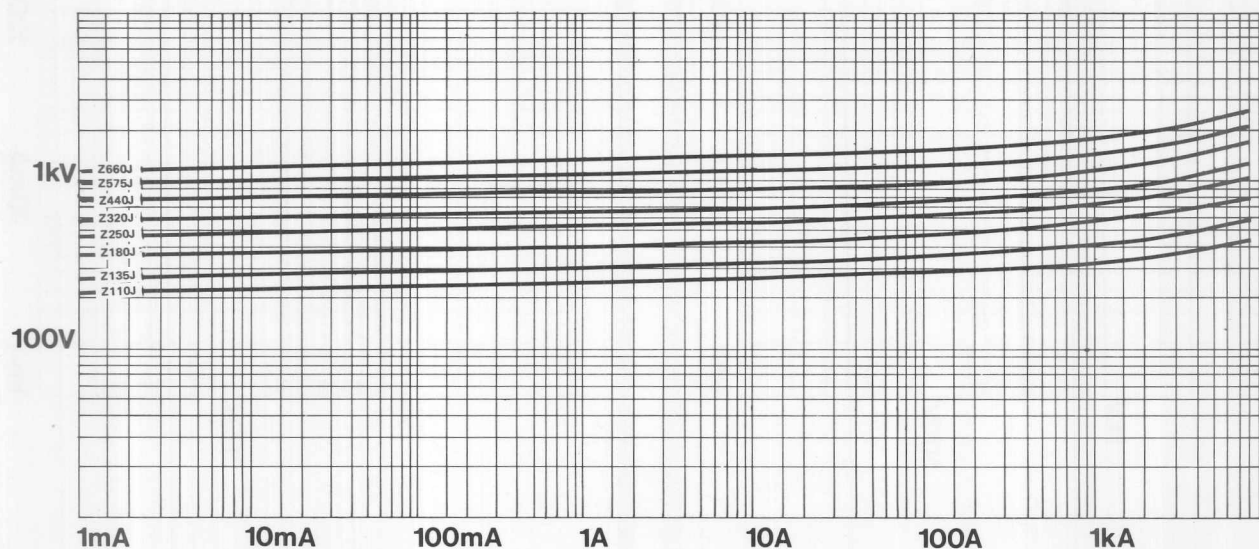
J' RANGE



8000 Amps 8/20 max.
275 Joules 10/1000 max.
23 mm Disc dia.

Max cont volts AC rms at 25° C	Type ref.	Max cont volts DC at 25° C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 60 Amps	m Watts cont	Cap pF.	Dim t mm	Type ref.
121	Z110J	157	171	60	320	1100	2400	4.5	Z110J
132	Z120J	172	187	70	350	1100	2000	4.5	Z120J
150	Z135J	195	210	80	380	1150	1800	5.0	Z135J
165	Z150J	214	233	90	420	1150	1650	5.0	Z150J
200	Z180J	260	283	110	500	1200	1350	5.5	Z180J
250	Z220J	325	353	130	610	1200	1000	5.5	Z220J
275	Z250J	358	389	150	680	1200	950	6.0	Z250J
320	Z280J	416	450	160	780	1250	950	6.5	Z280J
352	Z320J	458	498	180	850	1250	900	7.0	Z320J
420	Z380J	546	594	190	1000	1300	900	7.5	Z380J
460	Z415J	598	650	200	1120	1350	850	7.5	Z415J
484	Z440J	629	685	210	1190	1400	850	8.5	Z440J
550	Z500J	715	778	225	1320	1450	800	8.5	Z500J
632	Z575J	822	894	250	1480	1500	800	9.0	Z575J
726	Z660J	944	1027	275	1670	1550	750	10.0	Z660J

J' RANGE



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Z.O.M.M.s for N.E.M.P.

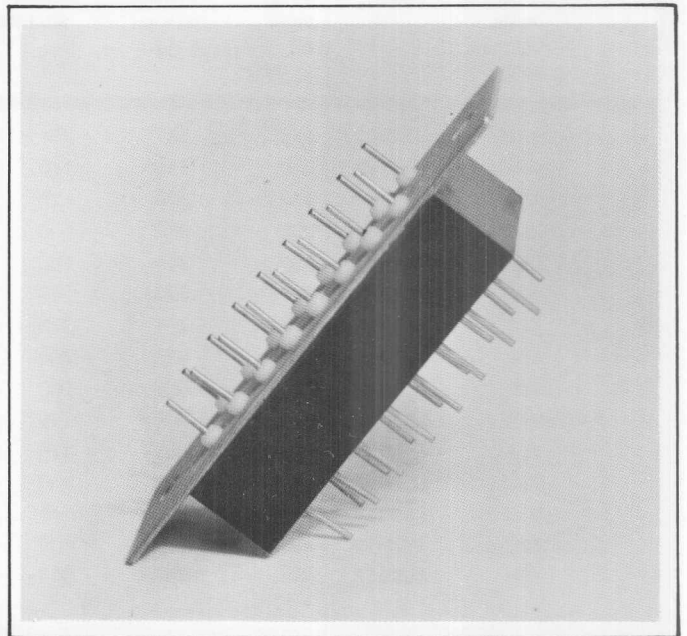
Nuclear Electro Magnetic Pulse Protection...

In the event of a high altitude (Exoatmospheric) detonation of a nuclear device an electromagnetic pulse is generated which will induce in any exposed conductor a high voltage transient. The range of the E.M.P. effect can be many thousands of kilometers and the magnitude of the induced transients can reach many tens of kilovolts causing damage to insulation, breakdown of semiconductors and consequent malfunction of critical equipment.

Most spark gaps will not operate fast enough to give protection or leave a high residual voltage on the line due to the need for a current limiting resistance.

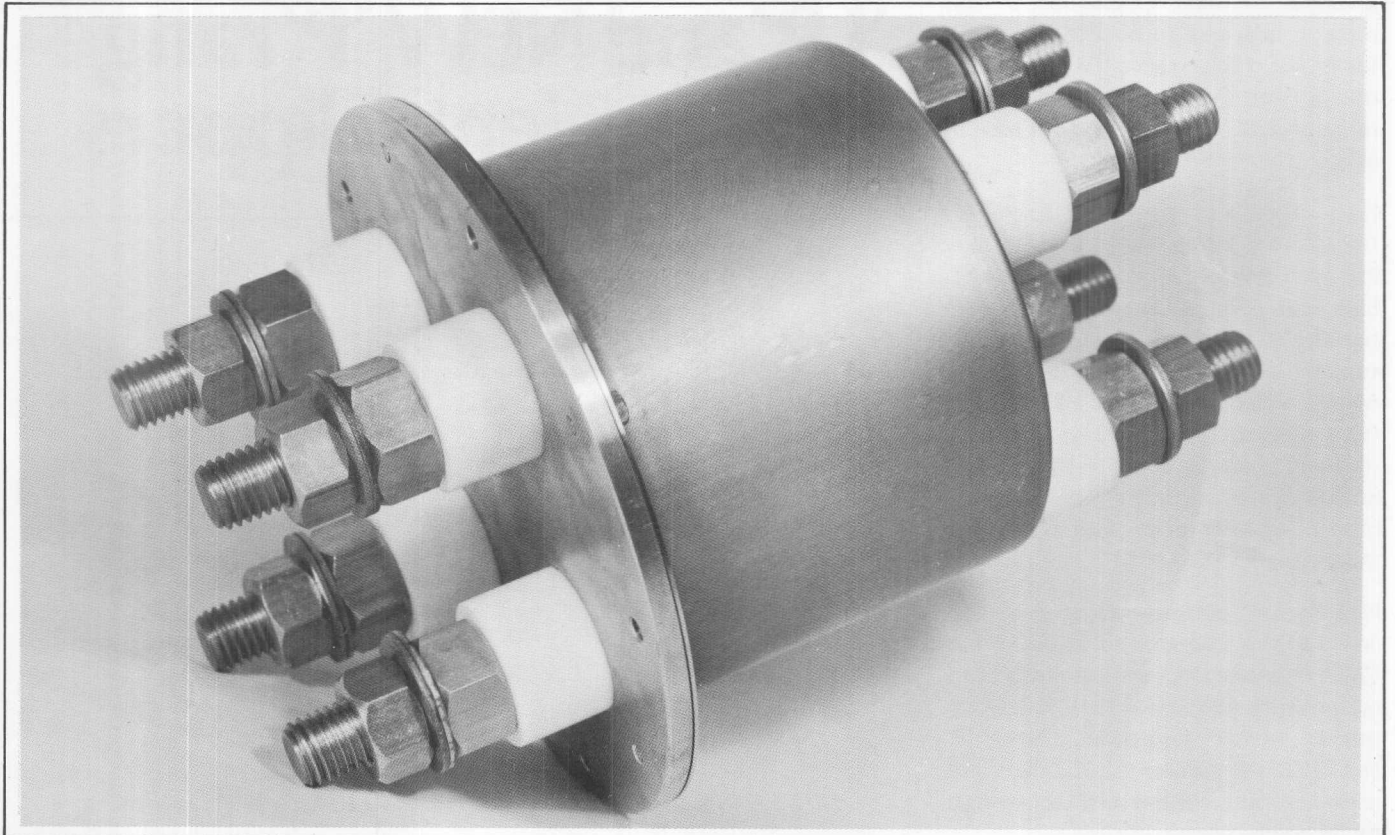
Z.O.M.M.s (Zinc Oxide Military Modules) incorporate the very high speed response of selected metal oxide devices in special low inductance assemblies designed to provide primary protection against this threat. Standard and 'Through-bushing' designs are available for applications through from signal lines to power distribution lines.

Illustrated are the ZOMM 123 providing 1000 Joule protection on each phase and neutral of a 4 wire 440 Volt 600 Amp. supply system and a ZOMM 108 designed for multiple signal line protection. Send for data sheets for more information on this extensive range of standard and custom designs.



ZOMM 123 ▽

ZOMM 108 △



'LP' & 'LP/2' RANGE

10,000 Amps 8/20 max.
450 Joules 10/1000 max.
35 mm Disc dia.

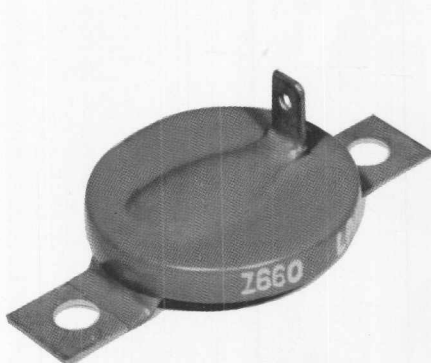
Max cont volts AC rms at 25° C	Type ref.	Max cont volts DC at 25° C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 100 Amps	Cap pF.	Type ref.
132	Z120LP	175	187	100	325	8000	Z120LP
150	Z135LP	200	210	120	360	7500	Z135LP
165	Z150LP	220	233	125	420	7000	Z150LP
200	Z180LP	260	283	130	490	6000	Z180LP
250	Z220LP	330	343	160	600	4500	Z220LP
275	Z250LP	370	389	180	650	4000	Z250LP
320	Z280LP	410	436	210	740	3700	Z280LP
352	Z320LP	470	498	230	840	3500	Z320LP
420	Z380LP	560	594	260	985	3200	Z380LP
460	Z415LP	615	645	290	1100	3000	Z415LP
484	Z440LP	640	685	320	1140	2800	Z440LP
550	Z500LP	710	778	350	1250	2400	Z500LP
632	Z575LP	825	894	375	1430	1800	Z575LP
660	Z600LP	850	933	400	1500	1600	Z600LP
726	Z660LP	950	1027	450	1650	1400	Z660LP

Effective transient suppression in high current, high energy circuits. 'P' stands for Power, Performance, Protection and this is what the new 'LP' and new 'P' range of **P/D Transient Clippers** have to offer.

Now available in the original single and new 2-hole fixing versions (LP/2 and P2) both types employ a large diameter, high mass zinc oxide element to provide repeatable safe protection against high currents and energy levels that would destroy a standard disc type in one shot. Both types are fitted with standard ¼" (6 mm) quick-fit spade terminals and both styles of mounting brackets combine positive earthing with good heat transfer performance.

High current performance on type 'LP' and 'LP/2' is increased to 10,000 Amps (8/20 microsecond wave) peak transient current with 450 Joules 10/1,000 microsecond energy absorption. Types 'P' and 'P/2' are capable of 15,000 Amps peak transient current and up to 650 Joules energy absorption.

'LP' and NEW 'P' range of Transient Clippers



LP/2 and P/2 2-hole fixing

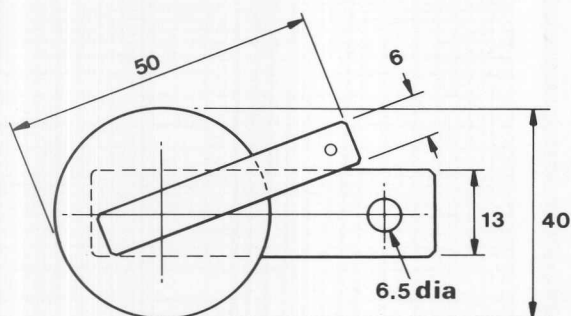


LP and P single hole fixing

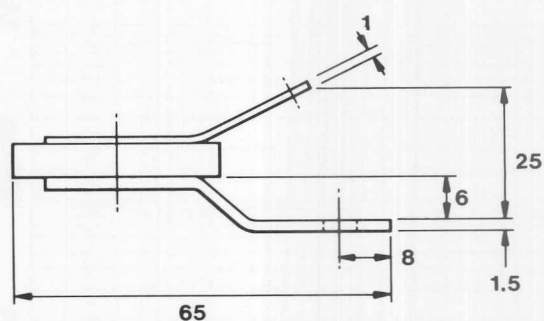
'P&P/2' RANGE

15,000 Amps 8/20 max.
650 Joules 10/1000 max.
35 mm Disc dia.

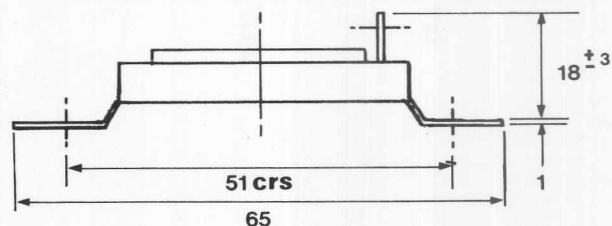
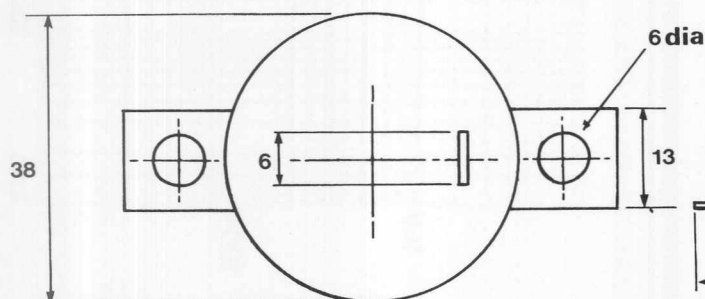
Max cont volts AC rms at 25° C	Type ref.	Max cont volts DC at 25° C	Varistor voltage min at 1 mA	Energy joules 10/1000	Clamping voltage at 100 Amps	Cap pF.	Type ref.
132	Z120P	175	190	140	325	8000	Z120P
150	Z135P	200	210	170	355	7500	Z135P
165	Z150P	220	235	180	420	7000	Z150P
200	Z180P	260	285	190	480	6000	Z180P
250	Z220P	330	345	240	585	4500	Z220P
275	Z250P	370	390	270	640	4000	Z250P
320	Z280P	410	440	310	730	3700	Z280P
352	Z320P	470	500	340	830	3500	Z320P
420	Z380P	560	595	390	970	3200	Z380P
460	Z415P	615	645	430	1080	3000	Z415P
484	Z440P	640	685	450	1120	2800	Z440P
550	Z500P	710	780	520	1220	2400	Z500P
632	Z575P	825	895	540	1400	1800	Z575P
660	Z600P	850	935	580	1470	1600	Z600P
726	Z660P	950	1030	650	1600	1400	Z660P



All dimensions in mm

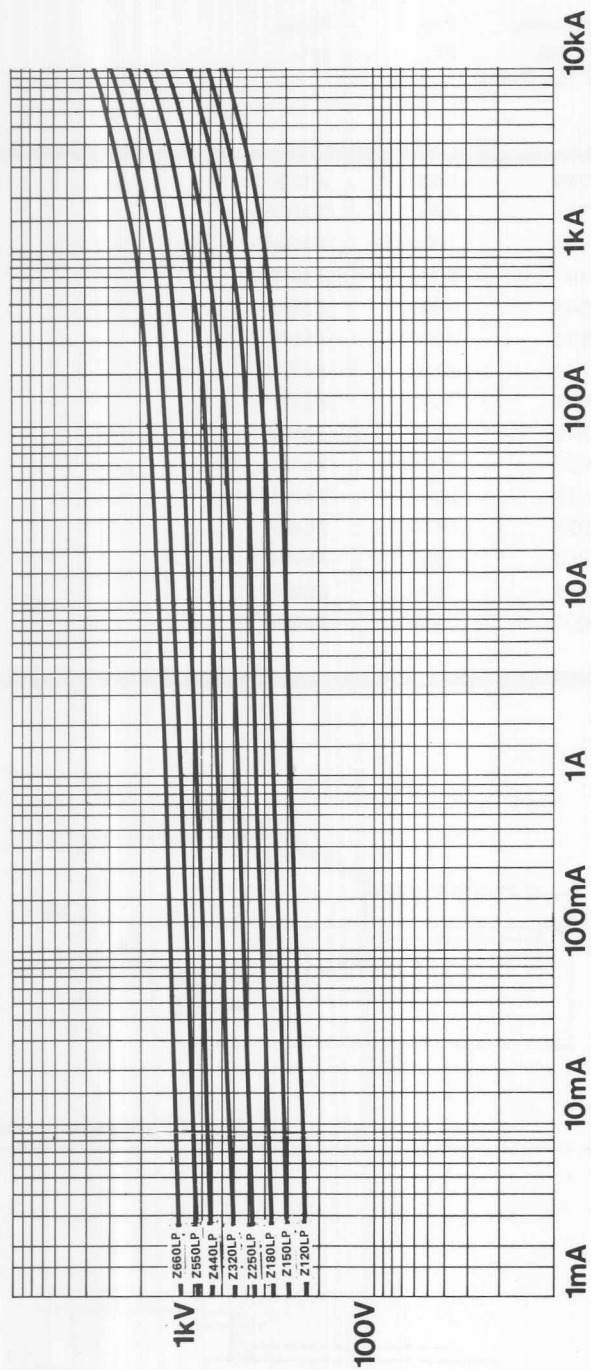


LP and P single hole fixing



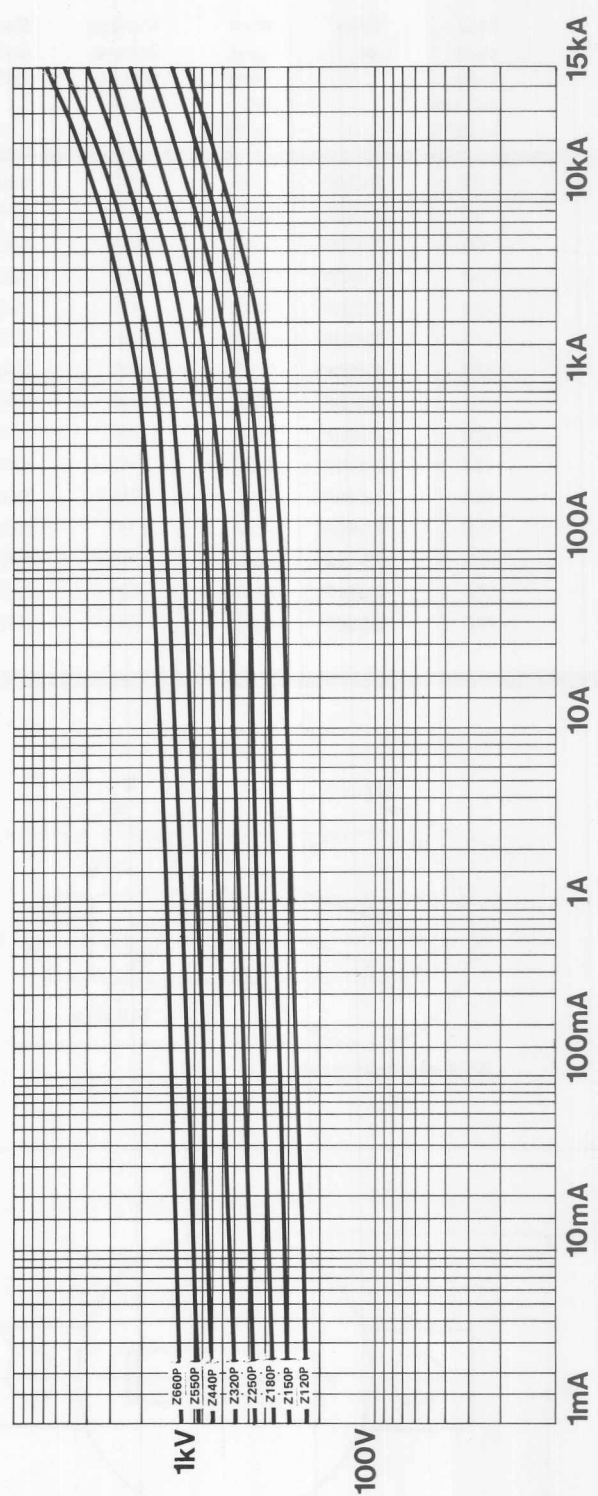
LP/2 and P/2 2-hole fixing

'LP & LP/2' RANGE



To improve readability some curves have been omitted but the information may be obtained by pro-rating.

'P & P/2' RANGE



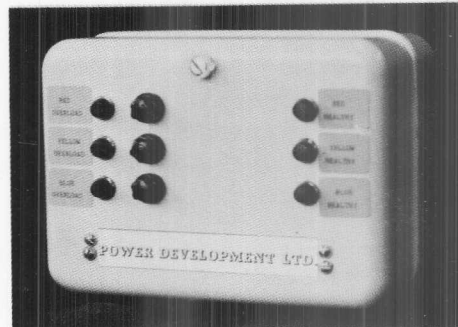
To improve readability some curves have been omitted but the information may be obtained by pro-rating.

Transient Clipper Assemblies

3TC SERIES

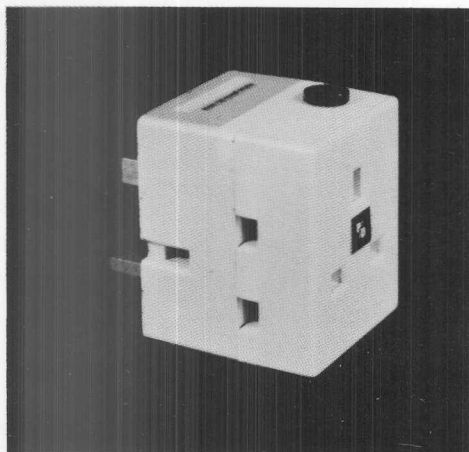
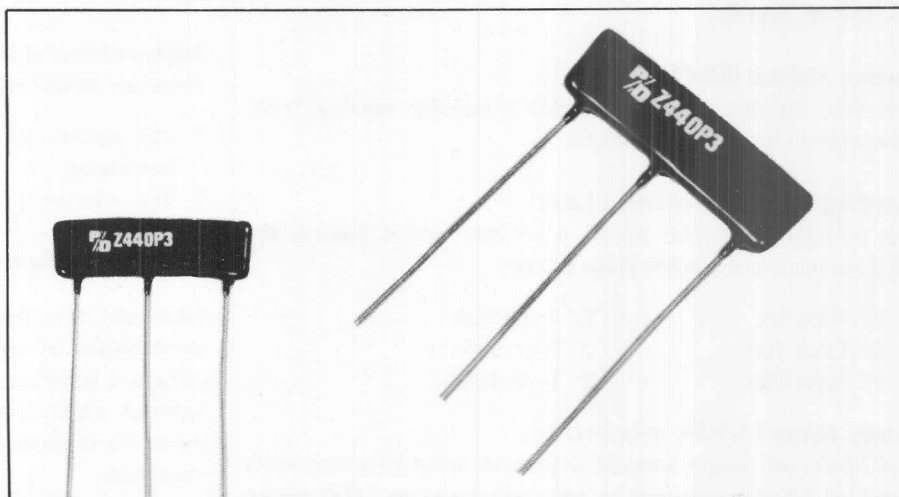
3 Phase Supply Protector. Type 3TC 208 and 3TC 440 Protection of the system at the distribution board protects all circuits from incoming transients. When used on circuits up to 100 Amps full load current transient voltages from full load switching will be suppressed to 400V (3TC 208) and 700V (3TC 440). These units incorporate

LP and P Transient Clippers as appropriate and are equipped with Protection Operating and Protection Overload condition monitor lights. The protection for each phase is independently fused.



Z440 P3C

3-phase star connected module for fractional HP. 3-phase motors designed to suppress transients developed phase to phase. Suitable for use up to 1 HP it should be treated as a Transient Clipper type 'C' when considering use on MAX duty in situations involving repeated switching and reversing.



ATC 250

Local protection of individual equipment such as computers, Hi-Fi equipment is especially convenient with the ATC 250. Simply plug into a 13 Amp socket and plug up to two pieces of equipment into the ATC 250. Transient voltages resulting from full load switching are suppressed to 650V.

Type	Part No.	Rated Voltage	Energy Joules	Clamping Voltage/Current A	Max Current 8/20
3-phase	Z440 P3C	440 p to p	20/phase	1150 p to p/5	800A
3-phase	3TC 208	210 p to p	200/phase	400V p to n/100	8/15000A
3-phase	3TC 415	415 p to p	200/phase	700V p to n/100	8/15000A
Single phase	ATC 250	250 p to n	20/phase	650V p to n/5	800A
Single phase	PTC 250	250 p to n	20/phase	650V p to n/5	800A

Notes

Type Designation. Typically Z250D refers to a 'D' size transient clipper recommended for use on 250V nominal AC systems. All Transient Clippers have a 10% continuous over voltage capability to allow for system fluctuations and higher than ambient temperatures.

In normal ambient conditions a 'Z250D' may be operated continually at 275V RMS.

Max. Continuous DC Volts at 25°C.

Refers to DC smooth, i.e. 5% ripple, for unsmoothed (rectified AC) use AC figures.

Varistor Voltage (Min^m)

The min. voltage developed across a varistor passing 1mA. Measured under pulse conditions.

Clamping Voltage (Protection Level)

The voltage developed across a variator whilst passing the 8/20 microsecond current given below:

'C' Type 5A	'G' Type 40A
'D' Type 10A	'J' Type 60A
'F' Type 20A	'P' Type 100A

Energy Joules 10/1000 microseconds

The maximum single impulse withstand using a current wave shape of 10 microseconds to peak value and on 1000 microseconds to half value on the wave tail.

Maximum Current 8/20 microseconds

The maximum single impulse high current withstand using a current wave shape of 8 microseconds to crest and 20 microseconds to half value on the wave tail.

Solderability and Resistance to Soldering Heat

Wired Transient Clippers employ solder coated copper wires and are quality controlled in line with IEC 68-2-20-1968 section 3.2.2 (230° ± 10°C), 3.2.4 (270° ± 10°C). Section 3.4 Solder globule method (less than 2 sec). Resistance to Heat Section 3.2.4 -350° for 3 to 4 secs. Suitable for Printed Circuit use.

Watts Dissipation

The continuous dissipation of the varistors unaided by heat sinks or forced cooling. The normal leakage current is well below this figure which need only be taken account of in repetitive pulse conditions where energy per pulse x number of pulses per second should be evaluated. Heat lost through wires/mounting brackets can be substantial and considerably enhance these figures.

Non-Linear Index

At low-voltage Transient Clippers appear as a capacitor. As voltage increases this effect disappears and the device acts as a voltage dependent resistor following the law $V^\alpha \propto I$, where α is in the range of 25 to 50. This is maintained throughout the normal operating range of the device. At very high current densities in the order of hundreds of Amps per square centimetre, the non-linear index progressively reduces with the curve approaching that of a linear resistor until the voltage stress is so high that breakdown occurs due to puncture or flashover.

Applications and Selection

There are three basic considerations:

1. The continuous voltage which the Transient Clipper must withstand.
2. The clamping voltage to which the transient must be suppressed.
3. The stored energy in the source of the transient (Joules).

When any inductive circuit (e.g. a solenoid coil) is interrupted some degree of current chopping takes place and a transient voltage is generated whose rate of rise follows the law ' $L di/dt$ '. Without suppression this voltage may rise to ten to thirty times it's original level damaging associated components and insulation.

With a Transient Clipper in circuit the transient is limited to the level at which the clipper passes the original coil current and the stored energy in the coil ($\frac{1}{2} LI^2$) is dissipated in the Transient Clipper without further current chopping.

E.G. A solenoid coil

rated 250V RMS duty cycle 20/Day x 15 Y = 100.000 ops. approx.

Current 100mA RMS = 141mA crest.
inductance 6.4 H.

$$\text{Stored energy} = \frac{1}{2} LI^2 = \frac{6.4 \times (.141)^2}{2} = 0.064J$$

From pulse lifetime curve 100,000 operations = 15% of max. energy.

$$\therefore \text{need } \frac{0.064}{.15} = .43 \text{ joules}$$

Clearly the 'C' range is more than adequate.

Select Z250C

Consult Z250C characteristic curve at 141mAmps clamping voltage/protection level is 550 volts.

Motor Protection

If all the motor data is available — number of starts, stored energy per phase etc. — an accurate theoretical design can be made. However, the variations are almost infinite and the following factors affect the design. Voltage. H.P./Watts/Current. Stored energy (which varies due to differences in inductance caused by frame size and the rotating magnetic field). Point of switching. Actual load at switching. Star or Delta winding. Number and type of starting. Speed/control arrangements etc. Without all this data designs must be generalised and conservative. The following table gives a guide to 'typical' motor stored energies and the list of recommendations makes the following assumptions:

1. 10 starts per day for 10 years on a 300 working day year.
2. Motor switching takes place under worst conditions (max. load and peak current) 10% of the time.
3. Motor switching does not take place during a stalled rotor D.O.L. start condition in large motors. Stored energy in this circumstance can be at least 5 times the figures allowed for in our recommendations and should be specially catered for.

HP/Watts	Typical stored energy/joules/phase		
	Motor type		
	Single phase 250V	3-phase 415V STAR	3-phase 415V DELTA
0.5/500	2	1	1
1/1000	3	1.5	1
2/2000	6	3	2
5/5000	15	6	4
10		11	6
20		20	11
50		45	25
100		80	45

Motor HP	Single phase 250V	3-phase 440V STAR	3-phase 440V DELTA
0.5	Z250C	Z250D	Z440D
1	Z250D	Z250D	Z440D
2	Z250F	Z250D	Z440D
5	Z250G	Z250F	Z440D
10	—	Z250G	Z440F
20	—	Z250J	Z440G
50	—	Z250LP	Z440J
100	—	Z250P	Z440LP

E.G. A single phase 400 watt drill

Rated voltage 250V RMS

Current 1.7 Amps RMS ($\times\sqrt{2} = 2.4$ Amps crest)

If all current is assumed reactive the inductance of the motor needs to be

$$\therefore \frac{250}{\pi \times 1.7 \times 2 \times 50} = L = 0.47 \text{ H}$$

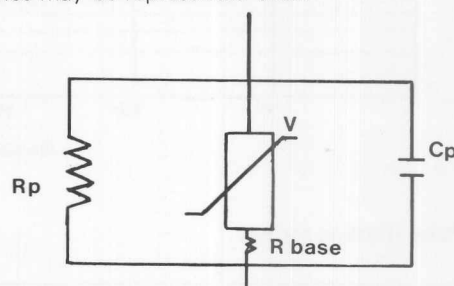
$$\text{stored energy} = \frac{1}{2} L I^2 = \frac{0.47 \times (2.4)^2}{2} = 1.3 \text{ Joules}$$

Recommendations table suggest a Z250C for this application. From the characteristic curve at 2.7 Amps the clamping voltage is 600 V. In practice the other circuit losses contribute to the suppression and a figure some 10% lower than this is more typical.

The stored energy is 1.3 Joules or only about 10% of the rated energy. From the pulse lifetime curve at least 1 million operations can be expected.

De-rating and Dependency on Temperature Frequency

The equivalent circuit of a Transient Clipper without lead inductance may be represented thus:



R base varies with size and for a 'J' type may be typically 1 milliohm per volt RMS rating at maximum current. Since the value is small and only has significance under extreme high current conditions, its negative temperature coefficient of resistance is disregarded for the purposes of de-rating. Up to rated voltage Cp varies little with temperature, voltage or frequency. The range -25°C to 130°C and 10 to 10^4 Hz. produces a total variation of around 20% not requiring additional de-rating. Rp is preponderant under DC conditions but this value is so high at around 10^6 to 10^9 ohms (varying with type) that no additional de-rating is required. The significant current carrier is V Varistor whose negative temperature coefficient of resistance with respect to voltage is in the order of -0.06 to $-0.04\%/^{\circ}\text{K}$ at greater than Varistor Voltage. Watts dissipation is a function of geometry, mounting and ambient temperature and normal leakage current is small compared with the dissipation figures given in the tables. Below 85°C no allowance is necessary for the de-rating of devices due to repetitive transients resulting in cumulative heating of the Transient Clipper. Above this temperature a figure of $2.4\%/^{\circ}\text{K}$ is recommended although it should be noted that heat loss through wires and mounting brackets is significant and can greatly enhance the figures in the tables.

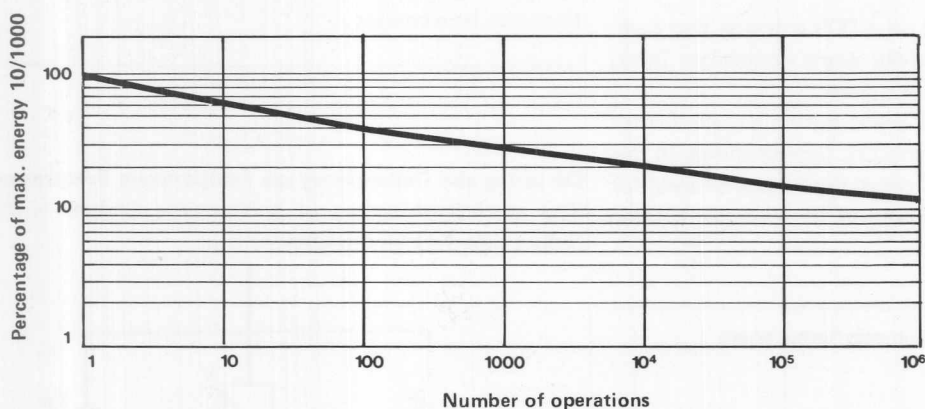
Stability and Life

Transient Clippers are designed to pass a quiescent current of only a few microAmps. Accelerated life tests indicate that this low current remains well below the acceptable Watts loss figures for many years. It is becoming standard practice to monitor Zinc Oxide devices at 1mA. In order to give a more accurate basis of comparison on larger diameter devices Power Development have standardised on 1.2mA/sq.cm. After 1,000 Hrs. type test at 85°C and maximum voltage the typical change in reference voltage at this level is -2%.

De-rating for repetitive duty is shown in the graph below where performance for multiple operations is given as a percentage of the maximum energy. The 'life' considered is based on a change in reference voltage of 10% at 1.2 mA/sq.cm.

Characteristic Curves

The characteristic curves shown are typical. For critical application intermediate ratings and special tolerances can be readily supplied but must be specified at the time of ordering.



Pulse lifetime ratings

In keeping with our policy of continual development and improvement we reserve the right to amend this specification without notice.



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